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Review

Gamification as a Behavioral Reinforcement Strategy in Pediatric Oral Health Education

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Abstract

Oral health is an important entity that can significantly impact overall health. Poor oral health doesn't only lead to dental and periodontal diseases; it also contributes to systemic health diseases, such as diabetes mellitus and cardiovascular diseases. Thus, it is critical to keep oral hygiene by implementing oral health care strategies. Establishing good oral health habits in childhood is crucial for lifelong well-being. Gamification is the creation of games with a primary objective of specific goal achievements, such as education, training, or health promotion. Studies have assessed the effectiveness of gamification use in multiple health conditions, including chronic diseases, rehabilitation, and preventive care, and mostly have shown positive health outcomes. However, its role in improving children's oral health is still unclear. This review aims to investigate the effectiveness of gamification-based methods in enhancing children's oral health. Advantages of gamification include intrinsic motivation, broad accessibility, broad appeal, broad applicability, and everyday life fit. Gamification-based applications were found to promote more responsive preventive oral care, improve oral health knowledge in high-risk populations, and decrease the risk of dental caries and gingival diseases. Future studies should validate these findings by conducting large-population-based studies.

Keywords: *Gamification, oral health, oral hygiene, oral health education*

Introduction

Oral health is an essential part of overall health and quality of life. Poor oral health is associated with various dental issues, such as caries, gum diseases, and oral infections, which significantly influence daily life, overall health, and academic performance (1-3). It has also been reported that poor oral health contributes to various systemic diseases, including cardiovascular disease, diabetes, and respiratory diseases (4). The risk of these systemic diseases can be significantly reduced by promoting oral health; thus, it is critical to keep proper oral hygiene and do regular dental check-ups (5).

Establishing good oral health habits in childhood is crucial for lifelong well-being. This establishment of good oral habits can be hindered by behavioral factors (6-9), particularly during the school years. School years play a vital role in shaping sustainable health behaviors, beliefs, and attitudes in children (8). Thus, children at this age should be prioritised when implementing and managing preventive oral health strategies (8). Despite worldwide efforts, tooth decay continues to be prevalent within this age group, highlighting the need for effective strategies to encourage proper oral self-care practices (10-12).

Gamification is a contemporary novel field of educational science (13). It has been incorporated into various health issues, such as chronic diseases, rehabilitation, and preventive care, and has shown positive health outcomes (14). Gamification is the development of game physical characteristics in non-game contexts and teaching-learning sessions for the purpose of knowledge acquisition (15). It provides a better learning experience by enhancing engagement and motivation and promoting active participation (14, 16, 17). Previous studies reported that gamification and serious game techniques can significantly improve the knowledge, attitude, and behavior towards oral health hygiene for various target groups, including the elderly, children, and intellectually disabled patients (16, 18, 19).

Although gamification has shown effectiveness in the education of multiple health fields, its role in improving children's oral health is still unclear. The aim of this review is to investigate the effectiveness of gamification-based methods in enhancing children's oral health and to evaluate its role as a behavioral reinforcement strategy in pediatric oral health education.

Methods

A comprehensive literature search was conducted in Medline (via PubMed), Scopus, and Web of Science databases up to November 5, 2025. Medical Subject Headings (MeSH) and relevant free-text keywords were used to identify synonyms. Boolean operators (AND', OR') were applied to combine search terms in alignment with guidance from the Cochrane Handbook for Systematic Reviews of Interventions. Key search terms included: "Gamification" AND "Oral Health Education" AND "Pediatric". Summaries and duplicates of the found studies were exported and removed by EndNoteX8. Any study that discusses the role of gamification in pediatric oral health education and published in peer-reviewed journals was included. All languages are included. Full-text articles, case series, and abstracts with the related topics are included. Case reports, comments, animal studies and letters were excluded.

Discussion

Overview of Gamification

Gamification has been a topic of interest across different research fields since its emergence around 2010. It has been widely used in the medical field as an approach to help individuals gain healthier habits. Like games and unlike personal informatics, gamification can induce an intrinsic motivation to initiate and keep the performance of health and well-being behaviors (20-24). One of the main advantages of gamification is its broad accessibility through mobile technology and ubiquitous sensors, making it more accessible than health games based on bespoke gaming devices (21, 25). Gamification is also more appealing, as it can be designed to be approachable to various populations by adding different elements to its design (21).

Furthermore, applications of gamification in chronic health risks have been various, including diet and weight management, physical activity,

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rehabilitation, medication adherence, drug use, and mental well-being, making it broadly applicable (22-24). Gamification is cost-benefit effective and fits everyday life (20, 22). Besides its positive role in health behaviors, gamification can also support well-being by generating positive experiences of basic psychological need satisfaction, such as engagement, relationships, meaning, and accomplishment (23, 26, 27).

Johnson et al. conducted a systematic literature review, aiming to evaluate the effects of gamification on health and well-being (28). They found that 59% of the studies included reported positive effects, while 41% reported mixed or neutral effects. According to these findings, they suggest that gamification can improve health and well-being. They also found that gamification has its highest positive effect on behavioral outcomes, whereas cognitive outcomes showed the least improvements. In addition, it has shown potential in improving health-related outcomes, such as medication and nutrition, and mental health outcomes, such as well-being, stress, and anxiety. Thus, there is initial support for gamification use in these fields. One of the important applications of gamification is oral health education, particularly in children.

Gamification and Children's Oral Health

Gamification has played a key role in promoting oral health in children in recent years. Multiple studies have examined the effects of different gamification applications on children's oral health. Moreira et al. (2024) conducted a scoping review aimed at analyzing the impact of gamification apps and their mechanisms on oral health care in children and adolescents (29). The educational content of these apps was evidence-based and of high quality, aiming to teach children oral self-care. Some of these also feature gamification elements and behavior change techniques. Out of the included studies, 73% reported favorable outcomes in children and adolescents after using oral health apps (29). These apps were found to encourage dietary changes (30), promote more responsive preventive oral care (31), improve knowledge in high-risk populations, and decrease the risk of dental caries and gingival diseases (32).

Oral health apps also led to significant improvements in tooth brushing quality, motivation for longer toothbrushing, and health indices (32). These apps were associated with better self-reported behavior and psychosocial factors in adolescents with fixed orthodontic appliances (33). A greater improvement in gingival status is commonly reported (34-36). Additionally, gamification apps significantly improved individuals' oral health knowledge, familiarity with oral health care themes, and engagement and commitment to taking care of their teeth (34-36). The analysis of participants' feedback showed a high satisfaction level with gamification as an approach to improving oral health care. Most studies reported a positive impact of gamification, particularly in children and adolescents, who are considered the main target audience of these apps (31, 32, 35-37).

Gamification oral health care apps included various health behavior change techniques. The most commonly used techniques were the "prompt intention formation" technique, the "provide instructions" technique, the "provide information on behavior-health link" technique, the "provide information on consequences" technique, the "model or demonstrate behavior" technique, the"provide feedback on performance" technique, and the "provide contingent rewards" technique (29). These techniques established the base of oral health care apps that are based on gamification in order to enhance engagement and promote positive behavior change. In the same review, game design elements of apps were also analyzed, and an emphasis on goal attainment, feedback, ideological incentives, and sense of ownership was observed in most of the studies (31, 34, 35, 37). Knowledge, provision, and self-monitoring of frequency and duration of toothbrushing were also found to be recurring game design elements in multiple apps (34). Hotwani et al. found that information provision, goal setting, feedback, progressive disclosure, and time pressure were frequently used (38). More recently, studies have developed other gamified oral health care approaches, such as the

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chatbot and the watch-summarize-question approach.

Emerging Gamification Approaches in Oral Health

Watch-Summarize-Question Learning Approach

The watch-summarize-question (WSQ) is a learning strategy developed to facilitate children's self-directed learning process by guiding them to summarize key points and pose questions while watching videos (39). It consists of three stages: watching videos, which requires focused attention to comprehend key concepts; summarizing main points, which helps organize information and deepen understanding; and generating questions based on the video content, which can significantly improve children's critical thinking. The WSQ strategy supports knowledge absorption and the development of essential skills, such as information organization, critical analysis, and problem-solving (39). A recent study by Chang et al. (2025) examined the use of the gamified WSQ learning strategy in changing oral health habits and skills, particularly flossing skills, comparing it with conventional video-based learning methods (40).

Results of this study showed that the WSQ gamified learning approach can improve participants' learning achievement in flossing knowledge. In contrast, the control group, which acquired knowledge through instructional videos, experienced a passive activity that limited opportunities for active practice and feedback (40). However, no significant differences in motivation for learning flossing techniques were observed between the experimental group using the WSQ gamified learning approach and the control group using the conventional video-based learning method. This indicates that the WSQ gamified learning approach does not substantially affect learners' motivation. The flossing skills performance was slightly better in the experimental group than in the control group; however, the difference was not significant statistically (40). This may be attributed to the nature of flossing skills, which require repeated practice over time.

Chatbot Approach

Chang et al. (2024) developed an oral self-care educational chatbot as an intervention tool to enhance children's oral self-care abilities (41). The behavioral change wheel (BCW) was integrated into the chatbot tool to enhance the effectiveness of this tool in changing oral health habits. The BCW framework consists of three layers: a "behavior system" at the hub, encircled by intervention functions and then by policy categories (45). At the core of BCW lies the COM-B model, which identifies capability (C), opportunity (O), and motivation (M) as the essential components of a behavior (B) system, with these components interacting to generate behavior (42). Gamification elements were also integrated into the chatbot design to improve educational, persuasive, and incentivizing functions. This chatbot is designed to provide children with comprehensive information about oral care and engage them in oral self-care through enhancing motivation, establishing capability, and creating opportunity (41). The Modified Chatbot Usability Questionnaire (CUQ) was used to measure the usability of the chatbot for oral self-care (43). According to responses from both parents and dental-care providers, the CUQ showed high likability and good usability of the chatbot as an intervention tool for promoting children's oral self-care (41). Additionally, feedback from participants indicated that the gamification design of the "quizzes and challenges" feature with level-breaking and level-up mechanisms was highly engaging and enjoyable for children, fostering their interaction with the chatbot.

Gamification Approach for Oral Health of Children with Autism Spectrum Disorder

Children with autism spectrum disorder (ASD) always exhibit poor oral health and face major challenges in keeping hygiene routines. Previous studies reported behavioral challenges during oral care and high levels of untreated caries, underscoring the critical need for targeted interventions (44, 45). Various interventions were developed to overcome these challenges, such as behavioral interventions like the "Tell–Show–Do" method, visual supports (PECS, social stories, video

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modeling), and environmental modifications such as sensory-adapted dental environments (46-51). Yerkibayeva et al. (2025) aimed to evaluate the effectiveness of a gamified oral hygiene mobile application called “Marzhan Tis”, which was developed specifically to support the development of oral hygiene skills in Kazakhstan children with ASD (52).

The application includes a visual schedule of daily brushing routines, animated instructions with familiar characters, a reward system, and built-in reminders for caregivers. Results of the study showed that the “Marzhan Tis” application app significantly improved oral hygiene skills in children with ASD level 1 (52). However, it may not be effective in all ASD patients, particularly in cases with greater severity that require personalized behavioral assistance. Furthermore, the application improved the ability of children with ASD to perform oral hygiene tasks independently, since it increased the number of children able to perform oral hygiene tasks independently from 10% to 40% of participants (52). Improvements were remarkable in toothbrushing skills, which are particularly challenging due to sensory sensitivities and behavioral resistance (53).

Future Directions

Future studies should develop standardized outcomes for measuring the effectiveness of gamification-based methods in education. Future studies should also focus on assessing the long-term effectiveness of gamification-based methods in oral health education in children through measuring the sustainability of behavior change. These methods need to be examined and validated across children from various cultures. The effectiveness of gamification should be measured in other age groups, such as in the study conducted by Chan et al. (2024), who measured the effectiveness of gamification in improving oral health knowledge, attitudes, and behaviors among older adults.

Conclusion

This review summarized the role of gamification as an oral health education tool in children. Gamification has shown promising results in enhancing children's oral health knowledge and habits, such as toothbrushing habits. However, these findings are inconsistent and still need further validation by conducting large-population cross-culture studies.

Disclosure

Conflict of interest

There is no conflict of interest.

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Ethical consideration

Non applicable.

Data availability

Data that support the findings of this study are embedded within the manuscript.

Author contribution

All authors contributed to conceptualizing, data drafting, collection and final writing of the manuscript.

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